Claims:

1. A unit-layer post-treatment catalyst chemical-vapor-deposition apparatus for forming a thin film on a substrate by using the catalyst action of an exothermic catalyst body resistance-heated in a reactive vessel capable of performing vacuum pumping, comprising:

a gas supply system capable of introducing flow rates of thin-film-component-contained gas and hydrogen gas into the reactive vessel like a pulse; and

an exhaust system capable of performing vacuum pumping and pressure control, wherein

the above thin-film-component-contained gas and hydrogen gas introduced like a pulse contact with the exothermic catalyst body and decompose and form a thin film for each unit layer on the substrate, and form a laminated thin film by surface-treating the thin film for each unit layer.

2. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

the surface treatment is one or both of the surface treatment by thin-film-component-contained gas excluding silicon and containing active species and the surface treatment by hydrogen gas containing active species.

3. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

the catalyst performance is regenerated by applying hydrogen gas to the exothermic catalyst body.

4. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

the surface treatment is one or both of the extracting treatment of surplus thin-film component and direct adding treatment of a thin-film component.

5. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

one of nitrogen gas and rare gas is used instead of the hydrogen gas.

6. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

the thin-film-component-contained gas is made of at least one of hydride of silicon and halide of silicon, and at least one of nitrogen and hydride of nitrogen.

7. The unit-layer post-treatment catalyst chemical-vapor-deposition apparatus according to claim 1, characterized in that

the thin-film-component-contained gas containing active species in the surface treatment is one or both of nitrogen and hydride of nitrogen.

8. A unit-layer post-treatment film forming method which is a catalyst chemical-vapor-deposition method for forming a thin film on a substrate by using the catalyst action of an exothermic catalyst body resistance-heated in a reactive vessel capable of performing vacuum pumping, comprising:

an activating step of introducing flow rates of thin-film-component-contained gas and hydrogen gas like a pulse, bringing the gases into contact with the exothermic catalyst body, and generating active species;

a film forming step of forming a thin film for each unit layer on a substrate; and

a surface treating step of performing surface treatment of a thin film for unit layer by hydrogen gas containing active species, and another surface treating step of surface-treating a thin film every unit layer by thin-film-component-contained gas including active species, wherein the surface treating step and the other surface treating step can be carried out in any order; characterized in that

a laminated thin film is formed by using a series of steps for respectively performing surface treatment after forming a film as one cycle, and repeating a plurality of cycles.

9. The unit-layer post-treatment film forming method according to claim 8, characterized by repeating one of the one surface treating step and other surface treating step a plurality of times during one cycle.

10. The unit-layer post-treatment film forming method according to claim 8, characterized in that

one or both of the one surface treating step and other surface treating step and a film forming step of forming a thin film for each unit layer on a substrate are continuously performed.

11. The unit-layer post-treatment film forming method according to claim 8, characterized by vacuum-pumping remaining gas after one of the film forming step, the one surface treating step and other surface treating step.

12. The unit-layer post-treatment film forming method according to claim 8, characterized in that

the one surface treating step is a step of extracting a surplus thin-film component and the other surface treating step is a step of adding a thin-film component.

13. The unit-layer post-treatment film forming method according to claim 8, characterized in that

the final step of one cycle is a step of performing surface treatment by thin-film-component-contained gas excluding silicon and containing active species.

14. The unit-layer post-treatment film forming method according to claim 8, characterized in that

one of nitrogen gas and rare gas is used instead of the hydrogen gas.

15. The unit-layer post-treatment film forming method according to claim 8, characterized in that

the thin-film-component-contained gas is made of at least one of hydride of silicon and halide of silicon, and at least one of nitrogen and hydride of nitrogen.

16. The unit-layer post-treatment film forming method according to claim 8, characterized in that

the thin-film-component-contained gas including active species in the surface treatment is one or both of nitrogen and hydride of nitrogen.

17. The unit-layer post-treatment film forming method according to claim 8, characterized in that

the thin-film-component-contained gas is made of monosilane gas and ammonia gas, the film forming step forms

a silicon nitride film for each unit layer on a substrate, and the other surface treating step is a step of surface-treating a silicon nitride film for each unit layer by ammonia gas including active species.

18. The unit-layer post-treatment film forming method according to any one of claims 15 to 17, characterized in that the final step of one cycle is a step of performing surface treatment by ammonia gas which is thin-film-component-contained gas including active species.